

EAST COLFAX AVENUE BUS RAPID TRANSIT (BRT) PROJECT TECHNICAL MEMORANDUM

Utilities

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City and County of Denver and Regional Transportation District

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Acronyms

BRT	Bus Rapid Transit
CCD	City and County of Denver
CCFO	Crown Castle Fiber Optic
CDOT	Colorado Department of Transportation
CE	Categorical Exclusion
COA	City of Aurora
COTREX	Colorado Trail Explorer
DRCOG	Denver Regional Council of Governments
DOTI	Denver Department of Transportation and Infrastructure
DUS	Denver Union Station
FTA	Federal Transit Administration
I-225	Interstate 225
LRT	Light Rail Transit
MTD	multi tile duct
NEPA	National Environmental Policy Act
SUE	Subsurface utility engineering
QLD	Quality Level D
PIP	Public Involvement Plan
ROW	right of way
RTD	Regional Transportation District

1. Project Description

The Federal Transit Administration (FTA) in coordination with the City and County of Denver (CCD) and the Regional Transportation District (RTD) are performing a National Environmental Policy Act (NEPA) evaluation for a Bus Rapid Transit (BRT) system that would serve East Colfax Avenue between downtown Denver and the RTD R Line light rail transit (LRT) Colfax Station at Interstate 225 (I-225) in Aurora (Project). The Project qualifies as a Categorical Exclusion (CE) per the FTA, which is the lead federal agency for this undertaking. The City of Aurora (COA), Colorado Department of Transportation (CDOT) and the Denver Regional Council of Governments (DRCOG) are active Project participants along with numerous public and private stakeholders. The CCD and the RTD implemented a robust stakeholder involvement program as a part of the Project and will continue to work with the stakeholders as design advances, funding is obtained, and construction is initiated.

The Project has completed preliminary design for BRT operations, including the identification of routing and station locations. The East Colfax Avenue BRT would run on existing, heavily traveled bus routes and would serve downtown Denver at the western end of the corridor, communities and businesses along East Colfax Avenue, and the Anschutz Medical Campus at I-225 and East Colfax Avenue in the east. Specifically, the 9.9-mile-long Project would include:

- Reliable BRT service (combined Route 15/15L) operating 24 hours per day, 7 days per week. This would include three service patterns all serving Denver Union Station (DUS) and three patterns that diverge at the eastern project terminus in the COA (including bus turnarounds at the RTD R Line LRT Colfax Station, Tower Road, and the R Line Aurora Metro Center Station). Two patterns would occur with 15-minute headways and one pattern with a 10-minute headway to provide a composite 4.3-minute BRT headway from DUS to the RTD R Line LRT Colfax Station. Connection between Civic Center Station and the Decatur/Federal Station is also provided via Route 16 (Figure 1).

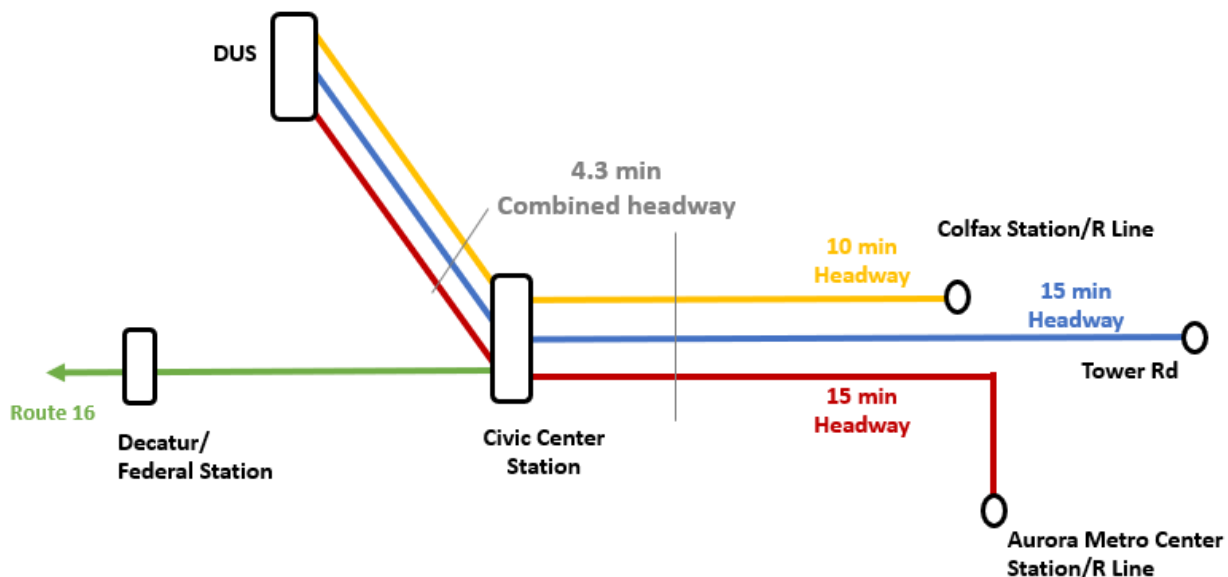


Figure 1. BRT Service Routing and Travel Headways

- Curbside-running alignment in existing 15th Street and 17th Street on-street bus lanes between DUS and Civic Center (East Colfax Avenue/Broadway) – 1.4 miles.
- Center-running alignment in dedicated bus-only lanes between Civic Center (East Colfax Avenue/Broadway) and East Colfax Avenue/Yosemite Street – 5.5 miles.
- Curbside-running alignment in mixed-flow traffic through COA between East Colfax Avenue/Yosemite Street and the existing RTD R Line LRT Colfax Station at I-225 – 3.0 miles.
- Upgraded signals to provide Transit Signal Priority (TSP) throughout the center-running section.
- Branded service, stations, and vehicles.
- Thirty-five (35) station locations with an average spacing of 0.32 miles.
- Enhanced station amenities including level boarding platforms, high-quality shelters, off-board fare collection, lighting, security features, real-time system traveler information, protection from traffic and weather, and public art opportunities.
- The COA has contributed funding for upgraded station improvements at certain locations between Yosemite Street and I-225 along East Colfax Avenue. At East Colfax Avenue and Havana Street, a station design similar to those planned in the center-running alignment section in Denver, but with a curbside alignment, would be located at the corner of East Colfax Avenue and Havana Street. In addition, level boarding platforms are planned at the intersections of East Colfax Avenue and Peoria Street, Moline Street, and the RTD R Line Colfax Station. The level boarding platforms would be constructed where the existing 15L shelters are currently located at these three locations, and the 15L shelters would be attached on top of each new platform.
- Dual northbound left-turn lanes on Colorado Boulevard at the intersections of East 13th Avenue and East 17th Avenue to improve traffic operations and travel times within the project area. An approximate 5-foot southbound travel lane shift would be required for the turn lane improvements. These improvements consist of widening of the roadway at the intersection by 10 feet. The added lane width would be accomplished by removal of the existing 5-foot median and shifting the existing curb line 5 feet to the west at both intersections.

Station locations and proposed features are highlighted in Table 1 and Figure 2 below.

Table 1. Proposed Station Features

Station	Stop Location	Full Signature BRT Station	Level Boarding Platforms	Existing Enhanced 15L Shelter to Remain	New Relocated Enhanced 15L Shelter	Branding and BRT Amenities
Denver Union Station (DUS)	Curbside					✓
Lawrence /16 th	Curbside					✓
California/15 th	Curbside					✓
Tremont/15 th	Curbside					✓
Lawrence /17 th	Curbside					✓
Champa/17 th	Curbside					✓
Welton/17 th	Curbside					✓

Station	Stop Location	Full Signature BRT Station	Level Boarding Platforms	Existing Enhanced 15L Shelter to Remain	New Relocated Enhanced 15L Shelter	Branding and BRT Amenities
Civic Center Station/Broadway	Curbside			✓		✓
Pennsylvania	Center	✓	✓			✓
Downing	Center	✓	✓			✓
Franklin/Park	Center	✓	✓			✓
Josephine/York	Center	✓	✓			✓
Fillmore	Center	✓	✓			✓
Madison	Center	✓	✓			✓
Colorado	Center	✓	✓			✓
Cherry	Center	✓	✓			✓
Elm	Center	✓	✓			✓
Hudson	Center	✓	✓			✓
Krameria	Center	✓	✓			✓
Monaco	Center	✓	✓			✓
Quebec	Center	✓	✓			✓
Syracuse	Center	✓	✓			✓
Uinta	Center	✓	✓			✓
Yosemite	Curbside			✓		✓
Chester	Curbside				✓	✓
Dayton	Curbside			✓		✓
Florence	Curbside				✓	✓
Havana	Curbside	✓	✓			✓
Kingston	Curbside				✓	✓
Moline	Curbside		✓	✓		✓
Peoria	Curbside		✓	✓		✓
Scranton	Curbside			✓	✓	✓
Children's Way	Curbside			✓		✓
Wheeling / Fitzsimons (VA)	Curbside				✓	✓
R Line LRT Colfax Station	Curbside		✓		✓	✓

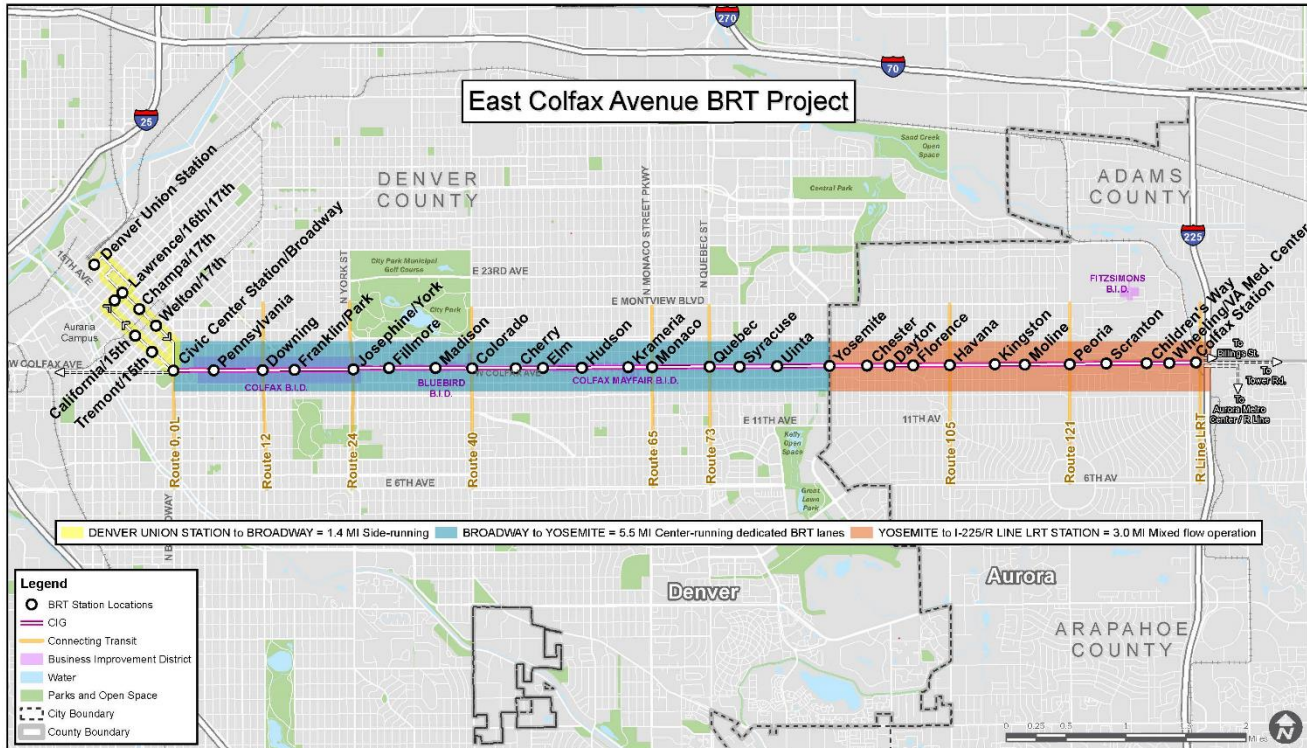


Figure 2. Project Area and Station Locations

1.1 PURPOSE OF THE PROJECT

The purpose of the Project is to provide additional person-trip capacity to meet growing travel demand with a high-quality, high-capacity, cost-effective, reliable, and safe transit solution serving the East Colfax Avenue corridor. This new service would provide a faster, more reliable, and more comfortable passenger experience compared with existing bus service, and thereby attract additional transit ridership. The Project would improve local and regional accessibility, mobility, safety, transit travel times and reliability, and passenger facilities in the most heavily used transit corridor in the Denver region.

1.2 NEED FOR THE PROJECT

The need for the Project is demonstrated by increasing transit travel demand in the corridor. The Project would aid the growth of transit ridership in the corridor by providing a comfortable, more frequent, and more reliable service for transit patrons, to a variety of destinations along the corridor. The Project also supports Denver’s Vision Zero initiative, making travel safer for pedestrians, cyclists, motorists, and transit riders. The Project would also support future investment along the East Colfax Avenue corridor, while continuing to provide an affordable travel option to help reduce household transportation costs. Seven needs have been identified and outlined for the Project:

- Serve the Growing Travel Demand
- Provide Improved Mobility
- Provide Equity and Affordability

- Improve Safety
- Provide Improved Access to Major Destinations
- Align Mobility Improvements with Land Use, Neighborhood and Economic Plans
- Improve Placemaking

2. Affected Environment

2.1 METHODOLOGY

An inventory of the existing utility infrastructure was completed to document a clear understanding of the utility constraints within the project area. Physical inventory of utilities at the Denver station locations between Broadway and Yosemite was performed in 2021 consistent with C.R.S. Title 9 Article 1.5 and ASCE 38-02. Physical inventory of utilities at the Aurora station locations between Yosemite and the RTD R Line LRT Colfax Station was performed May and July 2023 consistent with C.R.S. Title 9 Article 1.5 and ASCE 38-22.

Subsurface utility engineering (SUE) Quality Level D (QLD) data was collected for the project area. Utility data was obtained from utility owner provided records, as-builts, key maps, and other documentation. In Denver, the center running station locations were investigated in the field using a suite of advanced geophysical equipment to develop more certain utility mapping. These have been depicted based on professional judgement to Quality Level C (QLC) and/or Quality Level B (QLB).

Additionally, subsurface utility engineering (SUE) Quality Level D (QLD) data was collected for the remainder of the project area. Utility data was obtained from utility owner provided records, as-builts, key maps, and other documentation. In Denver and Aurora, the station locations were investigated in the field using a suite of advanced geophysical equipment to develop more certain utility mapping. These have been depicted based on professional judgement to Quality Level C (QLC) and/or Quality Level B (QLB).

2.2 UTILITY PRIORITIZATION

Throughout the design process, the team considered the location and type of utilities that may be in conflict with the proposed BRT infrastructure. In a utility dense corridor such as East Colfax Avenue, it is not realistic to avoid impacts to all utilities; however, the team recognized that some utilities may be considered more critical due to the value they provide and/or the cost or complexity to relocate. For this analysis, utility infrastructure is defined as either major or minor.

It is assumed that major utilities require a higher level of coordination during design, relocation design is higher in cost or complexity, have longer material or construction lead times, and/or require unique phasing. Conversely, minor utility conflicts would require less coordination and relatively lower cost and complexity to relocate or adjust. Additionally, many minor utility impacts are in public right of way (ROW) and are required to move prior to project construction based upon DOTI and COA ROW requirements.

Major utilities, as defined by the design team for this Project, include:

- Xcel Energy electric transmission lines and substations (below ground);
- Xcel Energy electric distribution, including three phase or mainline primary (below ground);
- Xcel Energy high pressure gas lines;

- Denver Water or Aurora Water conduit lines at least 24 inches or greater in diameter and/or irregular shaped pipes;
- Asbestos cement water lines;
- Denver Department of Transportation and Infrastructure (DOTI) or Aurora Water sanitary sewers at least 18 inches in diameter;
- Vitrified clay pipe sewer lines, of any size;
- Sewer and water pump stations or force main sewers; and
- Fiber backbone for ITS or national/regional networks, duct banks, and/or joint communications trenches (below ground).

Storm sewer impacts are excluded from this analysis as this type of utility is evaluated as part of drainage design.

3. BRT Station Potential Utility Conflicts

Utility conflicts are likely to occur at the BRT station locations based on the excavation required to construct platform/curb, canopies, windscreens, and new utility infrastructure to service kiosk, real-time messaging, lighting, security, and other elements (Figure 2). The potential major utility conflicts at platforms are identified by each station in the following subsections.

This technical memorandum does not provide a complete list of all potential impacts. Additional utility impacts may occur with roadway, sidewalk, drainage, or median improvements within the project area. As design progresses, there is more opportunity to minimize corridor-wide impacts and the construction of these improvements has a lower potential to result in impacts to underground utility relocations.

Utility impacts to minor utilities are not summarized in the following sections. Additional information on the type and condition of existing utilities and proposed method of conflict resolution would be developed in coordination with the utility owners as part of utility coordination to resolve impacts during final design. Continued design refinement as well as utility coordination would alter the total number of utility impacts. The impacts noted in this summary are a representation of the teams understanding of potential for major impacts at the 30-60 percent design progress.



Source: Iron Horse Architects

Figure 3. Typical Center-Running BRT Station with Canopy

3.1 DENVER CENTER RUNNING STATIONS

PENNSYLVANIA

Crown Castle and Lumen fiber optic features and Xcel Energy primary electric are the only major utility conflicts at the Pennsylvania station location. Comcast, Denver Water, DOTI traffic, and Xcel Energy electric and gas have minor utilities that may need to be adjusted or relocated at the station location. (Table 2).

Table 2. Pennsylvania Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Potential Conflict	119+20	RT	120+00	RT	Parallel
CCFO	Communication	Handhole	Relocate	119+60	RT	119+60	RT	NA
CCFO	Communication	Maintenance Hole	Relocate	119+90	RT	119+90	RT	NA
LUMEN	Communication	Line	Adjust/Relocate	117+35	LT	117+45	LT	Parallel
XCEL ENERGY	Electric	Line	Potential Conflict	116+00	RT	116+00	LT	Crossing

DOWNING

The potential for major utility impacts at the Downing station location includes DOTI, Lumen, and Lumen National (Level 3) fiber optic backbone lines. Denver Water, DOTI Traffic and Xcel Energy electric and gas have minor utilities that may need to be adjusted or relocated at the station location (Table 3).

Table 3. Downing Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
DOTI	Communication	Line - Fiber Optic	Potential Conflict	137+90	RT	144+40	RT	Parallel
DOTI	Communication	Handhole	Relocate	139+10	RT	139+10	RT	NA
DOTI	Communication	Handhole	Relocate	139+30	RT	139+30	RT	NA
DOTI	Communication	Handhole	Relocate	139+30	RT	139+30	RT	NA
DOTI	Communication	Handhole	Relocate	140+00	RT	140+00	RT	NA
DOTI	Communication	Handhole	Adjust/Relocate	140+17	RT	140+17	RT	NA
DOTI	Communication	Line - Fiber Optic	Adjust/Relocate	140+50	RT	144+40	RT	Parallel
DOTI	Communication	Handhole	Potential Conflict	140+82	RT	140+82	RT	NA
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	137+50	RT	137+50	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Relocate	139+00	LT	139+50	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Relocate	139+00	LT	139+50	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Relocate	139+10	LT	139+15	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	140+60	LT	143+70	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	140+60	LT	143+70	LT	Parallel
LUMEN (LEVEL 3)	Communication	Line - Fiber Optic	Adjust/Relocate	137+50	RT	137+80	LT	Crossing
LUMEN (LEVEL 3)	Communication	Line - Fiber Optic	Adjust/Relocate	138+80	LT	139+50	LT	Parallel

FRANKLIN/PARK

Comcast, DOTI, and Lumen fiber optic features and Xcel Energy primary electric are the only major utility conflict at the Franklin/Park station. Denver Water, DOTI traffic, DOTI sanitary sewer, and Xcel Energy electric and gas have minor utilities that may need to be adjusted or relocated at the station location (Table 4).

Table 4. Franklin/Park Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
DOTI	Communication	Line - Fiber Optic	Potential Conflict	154+80	RT	155+30	RT	Parallel
COMCAST	Communication	Line - Cable Tv	Potential Conflict	155+00	LT	155+00	RT	Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	153+00	LT	154+00	LT	Parallel
XCEL ENERGY	Electric	Line	Potential Conflict	155+00	LT	155+00	RT	Crossing

JOSEPHINE/YORK

Major utility impacts are limited to DOTI and Lumen fiber optic lines at the Josephine/York station. Denver Water, DOTI traffic, DOTI sanitary sewer, and Xcel Energy electric also has minor utility lines potentially in conflict at the station location (Table 5).

Table 5. Josephine/York Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
DOTI	Communication	Line - Fiber Optic	Adjust/Relocate	170+00	RT	171+60	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Relocate	179+50	RT	181+00	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Relocate	180+00	RT	181+00	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Relocate	180+15	LT	180+15	RT	Crossing
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	170+15	LT	171+25	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	170+33	LT	171+20	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	170+33	LT	171+20	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	176+23	LT	176+23	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	180+78	LT	182+80	LT	Parallel
XCEL ENERGY	Electric	Line	Relocate	175+85	RT	176+15	LT	Crossing
XCEL ENERGY	Electric	Handhole	Relocate	176+15	LT	176+15	LT	Parallel

FILLMORE

The Fillmore station has the potential to impact Lumen and Zayo long haul or backbone fiber. Potential minor utility impacts may include Denver Water, MCI Verizon, and Xcel Energy gas (Table 6).

Table 6. Fillmore Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	196+00	LT	197+50	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	196+00	LT	197+50	LT	Parallel
ZAYO	Communication	Line - Fiber Optic	Potential Conflict	193+60	LT	193+60	RT	Crossing

MADISON

Major utility impacts at the Madison station are limited to DOTI and Lumen fiber optic lines. Denver Water, DOTI sanitary sewer, DOTI traffic, and Xcel Energy electric and gas have the potential for minor utility conflicts at the station location (Table 7).

Table 7. Madison Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
DOTI	Communication	Line - Fiber Optic	Potential Conflict	218+50	RT	219+20	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Potential Conflict	218+60	RT	222+20	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	213+00	RT	213+40	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	214+50	LT	215+50	LT	Parallel

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	214+60	LT	215+00	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	215+00	LT	216+00	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	215+00	LT	217+00	LT	Parallel
LUMEN	Communication	Line	Adjust/Relocate	215+40	LT	215+70	LT	Parallel
LUMEN	Communication	Line	Potential Conflict	215+40	LT	217+00	LT	Parallel

COLORADO

Major utility impacts at the Colorado station includes Denver Water’s 36” brick water line, DOTI fiber, Lumen fiber, and Xcel Energy electric primary. Denver Water, DOTI sanitary sewer, DOTI traffic, RTD, and Xcel Energy all have minor utility features that may also be affected at this station (Table 8).

Table 8. Colorado Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
DOTI	Communication	Line - Fiber Optic	Potential Conflict	229+60	RT	229+60	LT	Crossing
DOTI	Communication	Line - Fiber Optic	Relocate	231+50	RT	235+00	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Relocate	232+00	RT	232+00	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Relocate	232+25	RT	232+25	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Relocate	233+30	LT	233+30	RT	Crossing
DENVER WATER	Water	Line	Potential Conflict	228+00	RT	229+00	RT	Parallel
XCEL ENERGY	Electric	Line	Potential Conflict	229+60	RT	229+60	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	231+05	RT	231+05	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	233+25	LT	233+25	RT	Crossing

CHERRY

The Cherry station has the potential to impact major Crown Castle, Lumen, Lumen National (Level3), Windstream (Paetec), and Zayo fiber optic lines. Denver Water, DOTI sanitary sewer, DOTI traffic, MCI/Verizon, and Xcel Energy electric all have minor utility features that may also be affected at this station (Table 9).

Table 9. Cherry Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Adjust/Relocate	247+50	RT	250+70	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Adjust/Relocate	247+70	RT	248+00	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Relocate	250+70	RT	252+00	RT	Parallel

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Potential Conflict	252+00	RT	254+00	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Adjust/Relocate	253+70	RT	254+00	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Adjust/Relocate	256+50	RT	257+50	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Adjust/Relocate	257+00	RT	258+00	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	241+90	LT	241+90	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	244+00	RT	244+00	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	244+00	RT	244+00	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	244+60	RT	244+60	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	246+00	LT	251+00	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	247+25	LT	247+25	RT	Crossing
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	247+50	RT	250+70	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	247+50	RT	250+70	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Adjust/Relocate	247+50	RT	250+70	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	250+00	LT	252+00	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	252+00	LT	256+00	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	255+60	RT	256+10	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	258+00	LT	259+00	LT	Parallel
LUMEN (LEVEL 3)	Communication	Line - Fiber Optic	Potential Conflict	238+00	LT	243+00	LT	Parallel
LUMEN (LEVEL 3)	Communication	Line - Fiber Optic	Potential Conflict	238+00	LT	243+00	LT	Parallel
LUMEN (LEVEL 3)	Communication	Line - Fiber Optic	Adjust/Relocate	241+40	LT	241+40	RT	Crossing
LUMEN (LEVEL 3)	Communication	Line - Fiber Optic	Adjust/Relocate	241+40	RT	241+40	LT	Crossing
LUMEN (LEVEL 3)	Communication	Line - Fiber Optic	Adjust/Relocate	244+00	RT	245+00	RT	Parallel
LUMEN (LEVEL 3)	Communication	Line - Fiber Optic	Adjust/Relocate	244+60	LT	244+60	RT	Crossing
PAETEC	Communication	Line - Fiber Optic	Potential Conflict	238+30	LT	238+30	RT	Crossing
PAETEC	Communication	Line - Fiber Optic	Potential Conflict	241+00	LT	242+00	LT	Parallel
ZAYO	Communication	Line - Fiber Optic	Potential Conflict	246+00	RT	246+00	LT	Crossing

ELM

The Elm station has the potential to impact major Crown Castle, DOTI, and Lumen fiber optic lines. Denver Water, DOTI traffic, MCI/Verizon, RTD, and Xcel Energy electric and gas all have minor utility features that may also be affected at this station location (Table 10).

Table 10. Elm Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Relocate	261+50	RT	264+00	RT	Parallel
CCFO	Communication	Handhole	Relocate	261+60	RT	261+80	RT	NA

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Relocate	262+58	RT	262+58	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Potential Conflict	263+50	RT	264+50	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Adjust/Relocate	260+00	RT	260+50	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Relocate	260+50	RT	261+00	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Relocate	260+50	RT	261+00	RT	Parallel
DOTI	Communication	Handhole	Relocate	261+60	RT	261+80	RT	NA
DOTI	Communication	Line - Fiber Optic	Relocate	262+58	RT	262+58	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Potential Conflict	263+50	RT	264+50	RT	Parallel
LUMEN	Communication	Maintenance Hole/Vault	Relocate	261+60	RT	261+80	RT	NA
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	262+00	LT	266+00	LT	Parallel

HUDSON

The Hudson station has the potential to impact major Crown Castle, DOTI, Lumen, and Zayo fiber optic lines. Denver Water, DOTI sanitary sewer, DOTI traffic, MCI/Verizon, and Xcel Energy electric and gas all have minor utility features that may also be affected at this station location (Table 11).

Table 11. Hudson Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - fiber optic	Relocate	280+00	Rt	283+50	Rt	Parallel
CCFO	Communication	Handhole	Adjust To Final Grade	282+10	RT	282+20	RT	NA
DOTI	Communication	Handhole	Relocate	277+30	RT	277+30	RT	NA
DOTI	Communication	Line - Fiber Optic	Potential Conflict	279+70	RT	279+70	LT	Crossing
DOTI	Communication	Line - Fiber Optic	Potential Conflict	280+00	RT	283+50	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Potential Conflict	280+00	RT	283+50	RT	Parallel
DOTI	Communication	Handhole	Relocate	279+70	LT	279+70	LT	NA
DOTI	Communication	Handhole	Relocate	279+70	LT	279+70	LT	NA
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	278+40	RT	278+50	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	278+45	RT	278+50	LT	Crossing
LUMEN	Communication	Maintenance Hole/Vault	Relocate	279+55	LT	279+55	LT	NA
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	280+00	LT	284+00	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	281+70	RT	281+70	LT	Crossing
ZAYO	Communication	Handhole	Adjust To Final Grade	282+10	RT	282+20	RT	NA

KRAMERIA

The Krameria station has the potential to impact major Crown Castle, DOTI, and Lumen fiber optic lines. Denver Water, DOTI sanitary sewer, DOTI traffic, MCI/Verizon, and Xcel Energy electric and gas all have minor utility features that may also be affected at this station (Table 12).

Table 12. Krameria Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Potential Conflict	300+00	RT	301+00	RT	Parallel
CCFO	Communication	Handhole	Relocate	300+90	RT	301+10	RT	NA
CCFO	Communication	Line - Fiber Optic	Relocate	301+00	RT	301+70	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Potential Conflict	300+00	LT	301+00	LT	Parallel
DOTI	Communication	Line - Fiber Optic	Potential Conflict	300+00	RT	301+00	RT	Parallel
DOTI	Communication	Handhole	Potential Conflict	300+60	LT	300+90	LT	NA
DOTI	Communication	Line - Fiber Optic	Potential Conflict	300+80	LT	300+90	RT	Crossing
DOTI	Communication	Handhole	Relocate	300+90	RT	301+10	RT	NA
LUMEN	Communication	Line - Fiber Optic	Relocate	297+00	LT	297+60	RT	Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	298+87	RT	298+87	LT	Crossing
LUMEN	Communication	Maintenance Hole/Vault	Relocate	300+60	LT	300+90	LT	NA
LUMEN	Communication	Maintenance Hole/Vault	Relocate	300+90	RT	301+10	RT	NA
LUMEN	Communication	Line - Fiber Optic	Relocate	301+00	RT	301+70	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	301+00	LT	303+00	RT	Crossing
LUMEN	Communication	Maintenance Hole/Vault	Relocate	302+88	LT	302+88	LT	NA

MONACO

At the Monaco station, Crown Castle, DOTI, and Lumen have potential major fiber impacts. Denver Water, DOTI traffic, MCI/Verizon, RTD, and Xcel Energy electric and gas have minor utility features that may also be affected at this station (Table 13).

Table 13. Monaco Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Potential Conflict	308+00	RT	313+50	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Potential Conflict	308+00	RT	314+00	RT	Parallel
CCFO	Communication	Handhole	Relocate	311+30	RT	311+40	RT	NA
CCFO	Communication	Handhole	Relocate	311+70	RT	311+70	RT	NA
CCFO	Communication	Line - Fiber Optic	Relocate	313+50	RT	314+00	RT	Parallel
DOTI	Communication	Line - Fiber Optic	Potential Conflict	308+00	RT	313+50	RT	Parallel

DOTI	Communication	Line - Fiber Optic	Potential Conflict	310+05	LT	310+10	RT	Crossing
DOTI	Communication	Handhole	Relocate	311+30	RT	311+40	RT	NA
DOTI	Communication	Line - Fiber Optic	Relocate	313+50	RT	314+00	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	308+00	LT	313+50	LT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	308+30	RT	308+30	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	313+05	RT	313+10	LT	Crossing

QUEBEC

The Quebec station has the potential to impact major Crown Castle, DOTI, Lumen, MCI, and Zayo fiber optic lines. Comcast, Denver Water, DOTI traffic, MCI/Verizon, and Xcel Energy electric have minor utility features that may also be affected at this station location (Table 14).

Table 14. Quebec Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Relocate	336+00	RT	336+00	RT	Parallel
DOTI	Communication	Handhole	Adjust To Final Grade	335+90	LT	336+00	LT	NA
DOTI	Communication	Handhole	Relocate	335+90	RT	336+00	RT	NA
DOTI	Communication	Line - Fiber Optic	Potential Conflict	336+00	RT	338+00	RT	Parallel
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	333+70	RT	333+80	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	334+55	LT	334+55	RT	Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	334+60	LT	334+60	RT	Crossing
MCI VERIZON	Communication	Line - Fiber Optic	Relocate	335+40	RT	336+00	RT	NA
MCI VERIZON	Communication	Handhole	Relocate	335+90	RT	336+00	RT	NA
ZAYO	Communication	Handhole	Relocate	335+90	RT	336+00	RT	NA
ZAYO	Communication	Line - Fiber Optic	Relocate	335+90	LT	335+90	RT	Crossing
ZAYO	Communication	Line - Fiber Optic	Relocate	335+90	RT	335+90	RT	Parallel
ZAYO	Communication	Line - Fiber Optic	Relocate	335+93	RT	335+93	LT	Crossing

SYRACUSE

The Syracuse station has the potential to impact major Crown Castle, DOTI, Lumen, and Zayo fiber optic lines. Denver Water's 48' steel line is also in conflict. Denver Water, DOTI traffic, MCI/Verizon, and Xcel Energy electric and gas have minor utility features that may also be affected at this station (Table 15).

Table 15. Syracuse Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Handhole	Relocate	349+70	RT	349+87	RT	NA
DENVER WATER	Water	Line	Potential Conflict	349+40	RT	349+40	LT	CROSSING

DOTI	Communication	Line - Fiber Optic	Potential Conflict	349+00	LT	349+50	LT	PARALLEL
DOTI	Communication	Handhole	Relocate	349+70	RT	349+87	RT	NA
LUMEN	Communication	Line - Fiber Optic	Relocate	348+50	RT	348+80	RT	PARALLEL
LUMEN	Communication	Line - Fiber Optic	Relocate	348+50	RT	349+00	RT	PARALLEL
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	349+00	RT	350+00	RT	PARALLEL
ZAYO	Communication	Handhole	Relocate	349+70	RT	349+87	RT	NA
ZAYO	Communication	Line - Fiber Optic	Relocate	350+00	RT	353+50	RT	PARALLEL

UINTA

The Uinta station has the potential to impact major Crown Castle, Lumen, and Zayo fiber optic lines. Comcast, Denver Water, DOTI sanitary sewer, DOTI traffic, MCI/Verizon, and Xcel Energy electric and gas have minor utility features that may also be affected at this station (Table 16).

Table 16. Uinta Station Utilities

Utility Owner	Type	Line or Feature	Impact	Station start	Side	Station end	Side	Parallel or Crossing
CCFO	Communication	Line - Fiber Optic	Relocate	364+00	RT	366+00	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Relocate	366+00	RT	370+00	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Relocate	366+00	RT	370+00	RT	Parallel
CCFO	Communication	Line - Fiber Optic	Potential Conflict	367+00	RT	367+05	LT	Crossing
LUMEN	Communication	Line - Fiber Optic	Potential Conflict	366+20	LT	366+70	LT	Parallel
ZAYO	Communication	Line - Fiber Optic	Relocate	364+00	RT	366+00	RT	Parallel
ZAYO	Communication	Line - Fiber Optic	Relocate	366+00	RT	370+00	RT	Parallel
ZAYO	Communication	Handhole	Adjust To Final Grade	367+43	RT	367+43	RT	NA

3.2 OTHER DENVER NON-STATION LOCATIONS

Non-station related BRT elements such as roadway, sidewalk/ramp, drainage, and median improvements may also impact utilities. Similar to the station areas, major fiber networks of Crown Castle, DOTI, Lumen National (Level 3), Lumen (CenturyLink), Windstream (Paetec), and Zayo may be affected along the project area. Test holes would be required to determine if these fiber ducts and networks can be protected in place. Specifically, Lumen and Lumen National (Level 3) have a 3" to 4" duct bank along the north side of East Colfax Avenue between Broadway and Rosemary, which then crosses to the south side of East Colfax Avenue from Rosemary to Peoria. These duct banks are a mixture of asbestos, and PVC conduit. Due to the duct material and copper cables, these ducts are a priority to protect in place. A proposed storm sewer on Dahlia Street, south of East Colfax Ave., crosses an existing 8" concrete asbestos water line. A test hole will be conducted in this location to ensure that the proposed storm drain does not impact the existing water line. If the test hole shows an unavoidable conflict, the design will be adjusted to avoid impacts.

3.3 AURORA SIDE RUNNING STATIONS

The proposed side running Aurora Stations, depicted in Figure 4 below, have fewer utility impacts than the Denver segment center-running stations described above. Utility impacts for each station are described below for the east and westbound platforms.



Figure 4. Havana Street Side Running Signature Station

YOSEMITE

The Yosemite eastbound station platform includes the following major utilities that may be in conflict with the proposed station:

- Lumen vault and duct, including a fiber multi tile duct (MTD) with copper cables that are difficult to adjust.
- RTD joint trench with fiber and electric.

CHESTER

- The Chester westbound station platform does not have any major utilities. Smaller water and electric lines are present.
- The Chester eastbound station platform includes a major Lumen fiber MTD duct.

DAYTON

- The Dayton westbound station platform does not have any major utilities. Smaller water and electric lines are present.
- The Dayton eastbound station platform may include a major Lumen duct and minor water and electric services.

FLORENCE

- The Florence westbound station platform does not have any major utilities, but a minor 16" water line is present.
- The Florence eastbound station platform may include a major Lumen duct and minor MCI fiber lines.

HAVANA

- The Havana westbound station platform does not have any major utilities.
- The Havana eastbound station platform has Xcel Energy three phase primary electric and a major Lumen duct.

KINGSTON

- The Kingston westbound station platform does not have any major utilities.
- The Kingston eastbound station platform has a higher density of Lumen fiber including copper lines in a major duct.

MOLINE

- The Moline westbound station platform does not have any major utilities.
- The Moline eastbound station platform has an Xcel Energy three phase primary electric line and Lumen duct.

PEORIA

- The Peoria westbound station platform may have an Xcel Energy three phase primary and mainline primary crossing at the eastern edge of the platform. Comcast also has a major fiber trunkline that appear to parallel and cross the station platform.
- The Peoria eastbound station platform may have a major Lumen duct.

SCRANTON

- The Scranton westbound station platform does not have any major utilities.
- The Scranton eastbound station platform may have a major Lumen duct.

CHILDREN'S WAY

- The Children's Way westbound station platform includes a Zayo metro backbone.
- The Children's Way eastbound station platform has an Xcel Energy three phase primary electric line.

WHEELING

- The Wheeling westbound station platform includes a Zayo metro backbone and Xcel Energy mainline primary electric line,
- The Wheeling eastbound station platform does not have any major utilities.

RTD R LINE LRT COLFAX STATION AT I-225

- The R Line Colfax Station platforms include an Xcel Energy mainline primary electric line.

4. Mitigation

4.1 UTILITY COORDINATION DURING FINAL DESIGN

This utility assessment is one of the initial steps to identify, and when reasonable, avoid or minimize potential utility impacts. As noted previously, this impact assessment is based on 30% level design. As design progresses, the team will continue to refine the civil and station platform design. The design team will facilitate one-on-one meetings with each utility owner to confirm existing and planned utility facilities in the project area and develop an approach to address these potential utility conflicts. In many cases, the existing utility infrastructure can be protected in place. The design team will work closely with the utility owners to confirm minimum clearance and any issues the utility owner may have during construction. When relocations or adjustments are required, utility owner meetings will specifically address timing, cost responsibility, and new location.

Additional subsurface utility engineering investigations (QLA test holes) will be completed during final design to confirm the depth of some key utility facilities. The utility coordination effort, test hole data, and latest design would be compiled in final utility relocation plans and project special provisions. Utility agreements will also be drafted and distributed to utility owners to confirm impacts and responsibilities during construction.

Special attention is given to coordinate the BRT's construction effort with other planned utility projects within the project area. Denver Water has programmed the replacement of the East Colfax Avenue water line between June 2023 through December 2024. This capital improvement project would replace aging infrastructure (a portion installed in 1880) on portions of East Colfax Avenue between Broadway and Xenia. This is one example of planned infrastructure that would be confirmed during utility one-on-one meetings.

4.2 UTILITY COORDINATION DURING CONSTRUCTION

During Construction, the contractor would work closely with the CCD and COA to ensure an effective Public Involvement Plan (PIP) is implemented, ensuring outreach strategies are implemented to inform property owners and tenants about construction-related issues such as the disruption of utility service. In addition, disruption of service provided by the existing utilities infrastructure would be limited to the extent possible.

4.3 SUMMARY OF POTENTIAL UTILITY IMPACTS

When a utility relocation or adjustment is deemed necessary, private utilities in public right-of-way must relocate at their cost. Xcel Energy, Comcast, and CenturyLink (now Lumen) have franchise agreements with CCD. Xcel Energy and Comcast have franchise agreements with COA. Relocations would occur consistent with the terms of those agreements. Generally, public utilities, such as water, sanitary sewer, and storm sewer are relocated at a cost to the Project. A summary of potential major utility impacts is broken down by utility type in Table 17 below. A majority of the major utility impacts are to fiber lines.

Table 17. Utility Impact Summary

Utility Type	Owners	Major utilities - estimated LF impacts at station location	Major utilities - estimated LF impacts along project area beyond station area	Concerns
Communication	Crown Castle, DOTI, Lumen (CenturyLink), Lumen National (Level 3), MCI-Verizon, Windstream (Paetec), RTD, Zayo	20,000	19,800	Major duct banks on north side of Colfax from Broadway to Rosemary and south side from Rosemary to Peoria Supply chain issues and extended construction material lead time No outages from November 1 to January 31
Traffic	DOTI	NA	NA	All minor adjustments
Electric	Xcel Energy	500	0	Xcel work request required in Denver Outage restrictions in summer
Gas	Xcel Energy	0	0	No high-pressure gas lines in project area. Minor lines less than 8" would need to be relocated. Outage restrictions in winter
Sanitary Sewer	DOTI	0	0	Relocation on minor lines is at project cost.
Water	Denver Water	100	0	This work is at project cost. Timing of water line replacement in Denver versus BRT project